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Field notes on the fossil localities in northern Thailand visited during the field season of February 1999

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Abstract

In February 1999, we visited several fossil yielding areas in northern Thailand. These areas, except for the Hab Pu Dai Cave Deposit locality, are of Miocene age (Ducrocq et al. 1994, Saegusa et al. 1999). A number of fossils were collected at these localities during our fieldwork in February 1999. The most extensively examined areas were Mae Soi and Sob Mae Tham, where we recognized 17 and 20 fossil localities, respectively. Our field survey suggests that there is still a good possibility to find new fossil sites in northern Thailand. In this article, we provide field information on each of these fossil localities.

1. Introduction

In the northern part of Thailand, around Chiang Mai, there are a number of intermontane basins where Miocene sediments were accumulated. Miocene fossil remains have been reported from this area by previous authors (e. g. see Ducrocq et al. 1994 and references cited in it). Among them is a non-cercopithecoid catarrhine named Dendropithecus orientalis (Suteethorn et al. 1990). This taxon is represented only by a single lower molar at present, and its assignment to the genus Dendropithecus is doubted (Harrison & Gu 1999). However, the presence of this fossil primate in Thailand is of interest, because compared to relatively large numbers of Neogene catarrhine fossils discovered in China to the east and in Indo-Pakistan to the west, very little is known on their evolution during the late Cenozoic in Southeast Asia. Therefore, further paleontological fieldworks are needed in this region.

During the field season of February 1999, we carried out our fieldwork at several areas in northern Thailand, most of which are estimated as Miocene in age (Fig. 1). Through

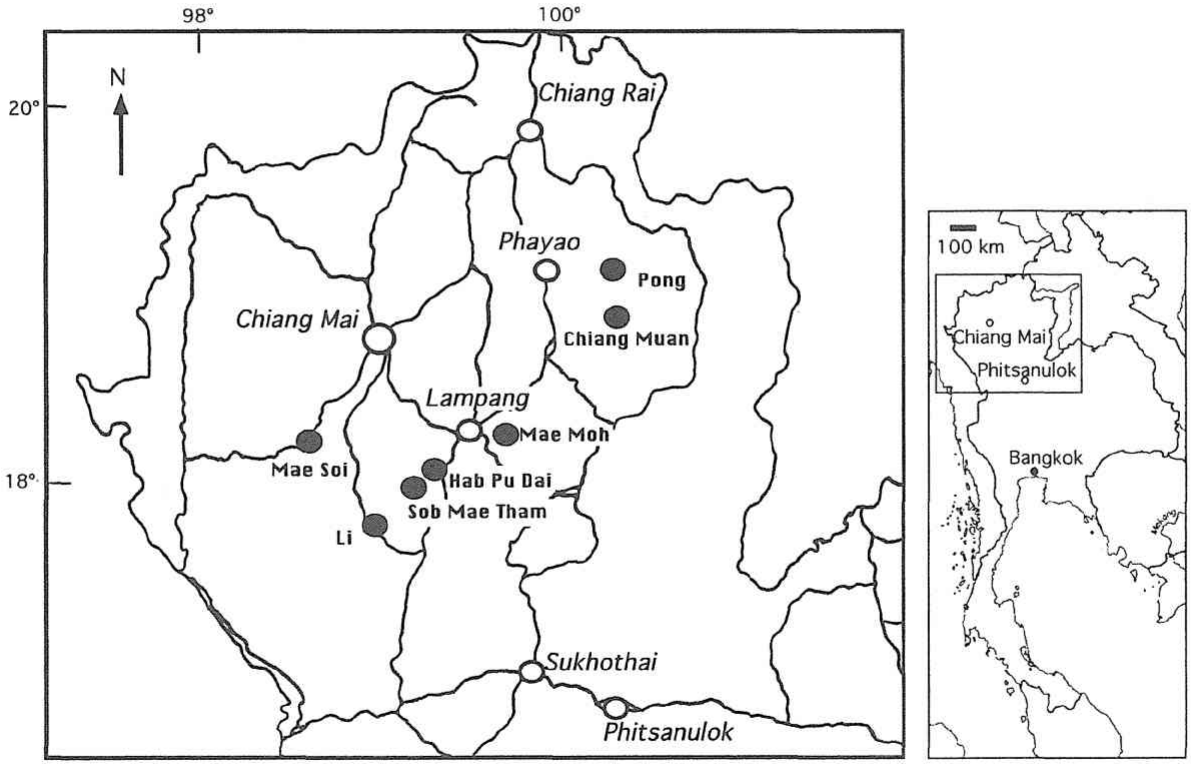

Figure 1. Black circles indicate the fossil yielding areas that we visited during the field season of February 1999 in northern Thailand.

our fieldwork, a certain number of fossils were recovered. This article aims to keep the records of the information on the fossil localities that we visited during this field season. A short description of each locality is given with the latitude and longitude measured by global positioning system (GPS: Garmin GPS II, datum WGS84), when available.

2. Notes on the fossil localities

2-1. Mae Soi (Fig. 2 & 3)

Mae Soi is a village near Chom Thong about 60 km southwest of Chiang Mai. The village is located on the way from Chom Thong to Hot. In 1997, local people discovered fossilized proboscidean bones on a hill west of the village. The hill, by chance, is called Doi Chang (= Elephant Hill). They brought the fossils to a local temple in order to hold a religious service for the spirit of this ancient animal. After the ceremony, most of the fossils were buried again in the original place (DCh1), but some of them were sent to the National Museum in Chiang Mai for a scientific investigation. Then, the director of the Museum informed one of the authors (B. Ratanasthien) of the discovery of the proboscidean fossils in Mae Soi. Consequently, Ratanasthien and her Japanese colleagues (H. Saegusa & H. Nakaya) recognized the importance of the specimen, and started excavating the rest of the specimen at Doi Chang in 1997 (Saegusa et al. 1999). The excavation was

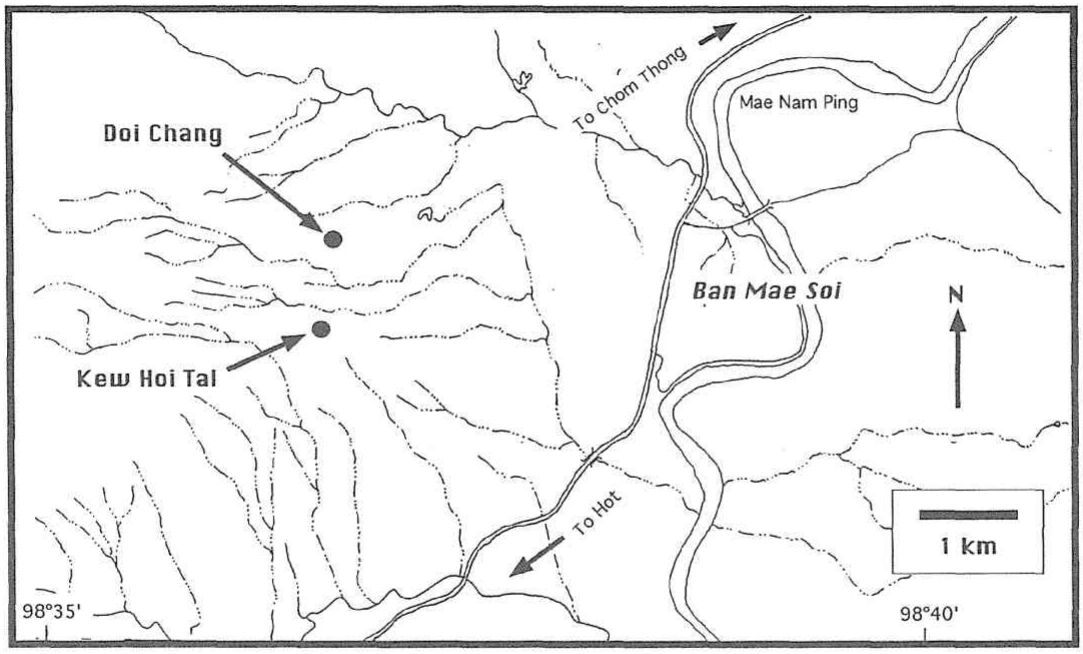

Figure 2. Fossil yielding subareas in the Mae Soi area, near Chom Thong, in the Chiang Mai Province.

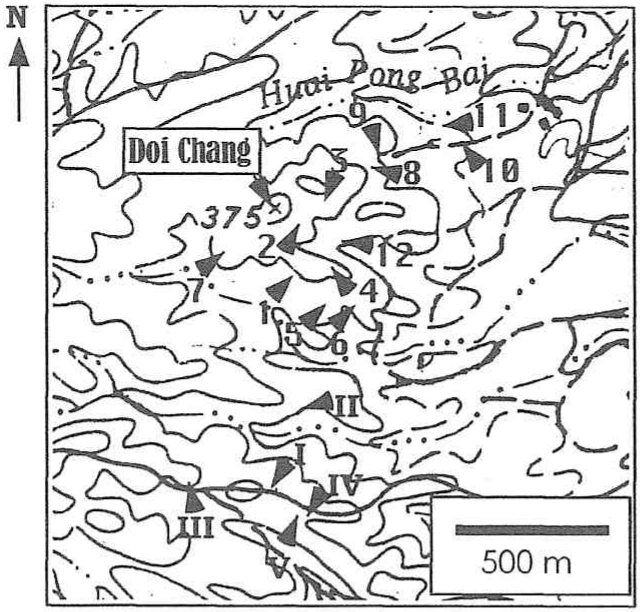

Figure 3. Fossil localities in the Doi Chang and Kew Hoi Tal subareas. The Arabic and Roman numbers indicate the fossil localities with the prefix DCh (Doi Chang) and with the prefix KHT (Kew Hoi Tal), respectively.

completed in the next field season (February 1999), and all the remains of the proboscidean fossil were brought to the National Museum in Chiang Mai. In addition, during the field season of February 1999, we carried out surface collection at a number of localities in Doi Chang and Kew Hoi Tal (a small hill ca. 500 m south of Doi Chang). From the main road through farms of longans, one can access up to the vicinity of Doi Chang by car. We usually parked our vehicle beside a small pond. We called this parking place as the Road End (GPS data: N 18° 17' 06.7" E 98° 36' 50.8"). From the Road End to Doi Chang was about 15 minutes walk. The description of each locality in this area is as follows.

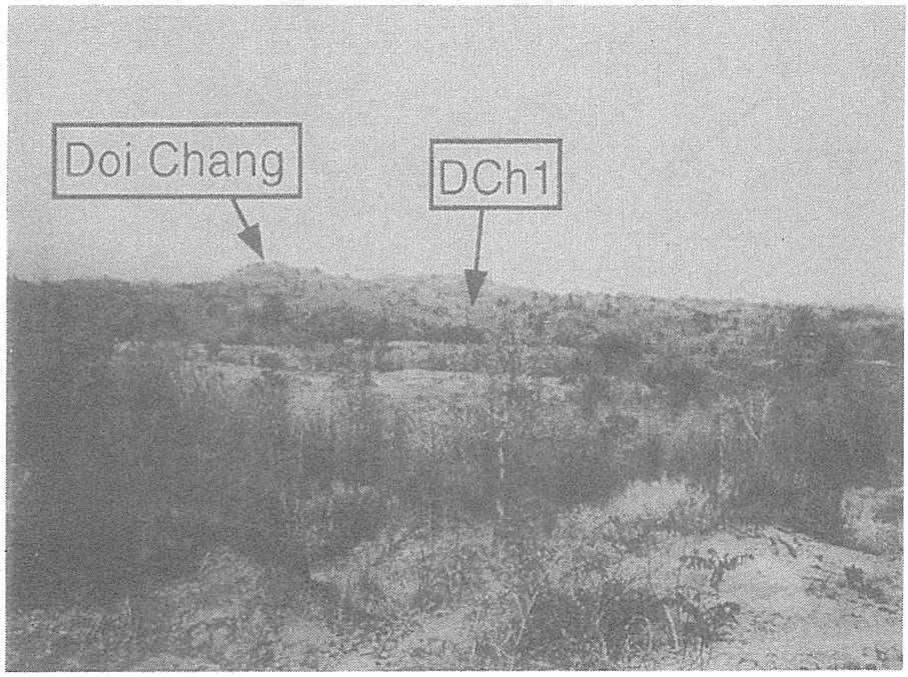

Figure 4. Doi Chang (= Elephant Hill) and the locality DCh1 viewed from the locality KHT1 (= from the south). Between DCh1 and KHT1 lies the locality KHT2.

2-1-1. Subarea: Doi Chang (Locality Prefix: DCh) (Fig. 4)

Locality DCh1 (GPS data: N 18° 17' 10.5" E 98° 36' 28.7"): Another name is "Mastodon Site". The skull, upper half of the body and pelvis of a tetralophodont gomphothere were recovered during the field season of 1997. In the present season, the remaining ribs were excavated. In addition, the hindlimbs were discovered by ca. 5 m west of the upper part of the body. Probably, the skull, ribs, vertebrae, pelvis and these hindlimbs belong to the same individual of the larger species among the two proboscidean taxa in Mae Soi. The gomphothere skeleton was preserved in the lowermost part of a yellowish sandstone layer, which is underlain by a pale-colored silt layer. Some bone fragments were collected on surface, among which a phalanx of a perissodactyl was included.

Locality DCh2 (GPS data: N 18° 17' 15.3" E 98° 36' 25.3"): This locality lies near the top of the Doi Chang hill. The surface is gently sloping southwards. The sediments are intercalated sandstone and reddish silt. We found fossils such as a tragulid mandibular fragment with teeth, a deciduous molar of a gomphothere, and fragments of turtles.

Locality DCh3 (GPS data: N 18° 17' 20.2" E 98° 36' 27.5"): This locality is a slope a few tens of meters east of the locality DCh2. Petrified woods were found on surface around the lower part of the slope on 10th February. On the next day, rhinocerotid dental remains

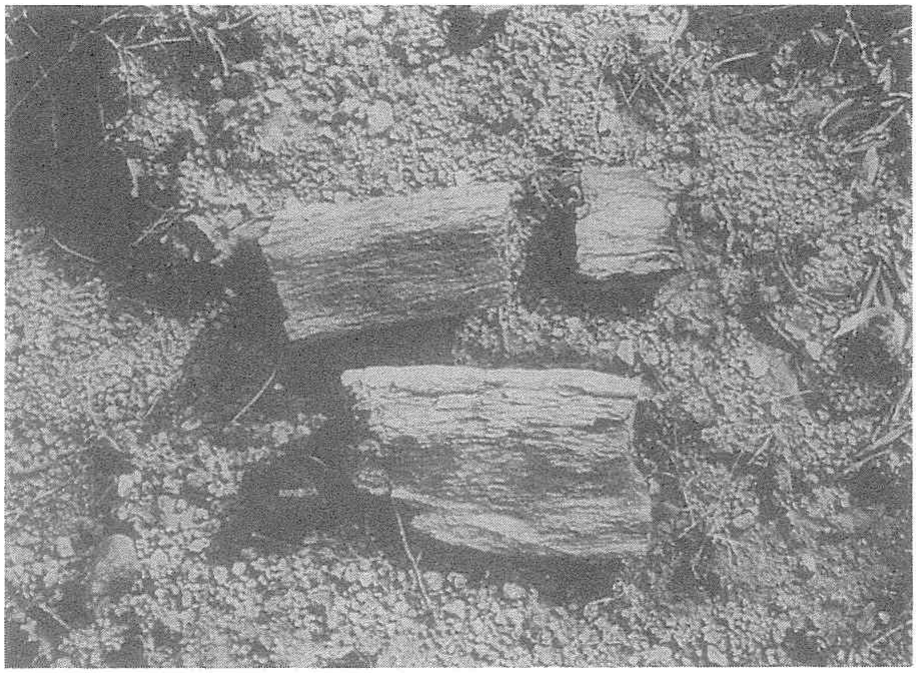

Figure 5. Petrified woods at the locality DCh7.

were discovered near the top of the slope, along with fragments of proboscidian teeth and of turtles.

Locality DCh4 (GPS data: N 18° 17' 09.8" E 98° 36' 32.7"): This is a small outcrop along the footpath coming from the Road End to the locality DCh1. Nakaya and Saegusa discovered rhinocerotid fossils on the way back to the Road End on 12th February. Yellowish and reddish sandstones are intercalated.

Locality DCh5 (GPS data: N 18° 17' 10.4" E 98° 36' 30.2"): This locality is close to the "Mastodon Site" (DCh1), only a few tens of meters away to the east, and is separated from the latter by a gully. This locality was not productive in fossils. A bone fragment in yellowish sandstone matrix was found on 12th February, and additional bone fragments of large-bodied mammal were collected on the next day.

Locality DCh6 (GPS data: N 18° 17' 07.9" E 98° 36' 31.3"): This locality lies above a small cliff a few tens of meters east of the locality DCh5. A fault runs between the localities DCh5 and DCh6. Dark-colored petrified woods were found on surface. They were fractured into small fragments. The surface is yellowish fine sand with a lot of whitish pebbles.

Locality DCh7 (GPS data: N 18° 17' 16.4" E 98° 36' 18.1"): This is a locality of

Figure 6. Locality KHT3. One of us (T. Tsubamoto) excavating a proboscidean humerus.

petrified woods (Fig. 5). It is located on a ridge, ca. 50 m west of the summit of Doi Chang. Dark-colored petrified woods were scattered on surface. Some of them were relatively large fragments, but their lengths were ca. 30 cm at largest.

Locality DCh8 (GPS data: N 18° 17' 19.6" E 98° 36' 33.5"): This locality is a few tens of meters east of the hill top of the locality DCh3, along a footpath which goes downhill. Small fragments of petrified woods were collected on surface. Yellowish silt was exposed on the ground.

Locality DCh9 (GPS data: N 18° 17' 23.0" E 98° 36' 34.7"): This locality lies father down on the footpath from the locality DCh8, and also produced fragments of petrified woods. Orangish coarse sandstone was exposed with plenty of pebbles on surface.

Locality DCh10 (GPS data: N 18° 17' 26.2" E 98° 36' 37.2"): This is located several meters down from the locality DCh9 along the footpath. A fragment of a rhinocerotid tibia was discovered.

Locality DCh11 (GPS data: N 18° 17' 28.4" E 98° 36' 35.8"): This locality is situated midway on the slope north of the locality DCh10. There were several petrified woods. Lager ones were ca. 30 cm long. The surface soil was reddish with plenty of pebbles.

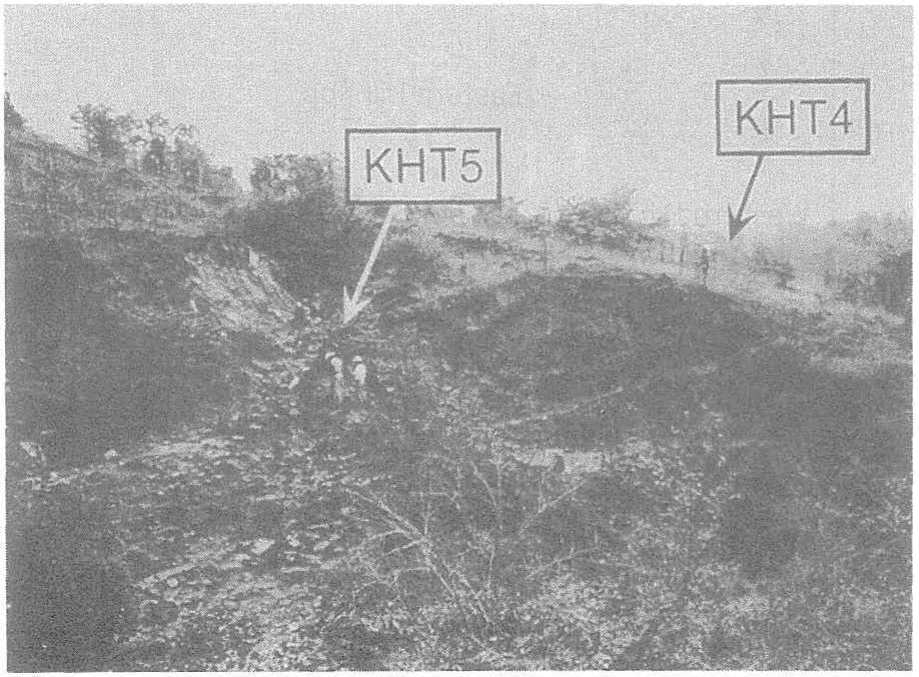

Figure 7. Localities KHT4 & KHT5.

Locality DCh12 (GPS data: N 18° 17' 20.0" E 98° 36' 33.3"): This locality lies near a pond. Beyond a gully to the southwest (S30°W) is the locality DCh4 on a hill. Yellowish sandstone was exposed on the ground. Bone fragments of large animals were found on surface.

2-1-2. Subarea: Kew Hoi Tal (Locality prefix: KHT)

Locality KHT1 (GPS data: N 18° 16' 58.0" E 98° 36' 23.4"): This is located on the ridge of the Kew Hoi Tal hill. Fossils were scattered on surface. They include tooth fragments and postcranial bones of proboscideans and gastropod shells.

Locality KHT2 (GPS data: N 18° 17' 03.0" E 98° 36' 23.5"): This is a flat place down the northern slope of the locality KHT1. Fossils were few. Two gastropod shells were collected. The surface soil is reddish, and pebbles were scattered on surface.

Locality KHT3 (GPS data: N 18° 16' 59.6" E 98° 36' 12.4"): This locality lies on a path leading to the west from the locality KHT1. Two pieces of a proboscidean humerus were discovered, being half-buried in the surface soil (Fig. 6).

Locality KHT4 (GPS data: N 18° 16' 55.3" E 98° 36' 25.3"): This locality (Fig. 7) is

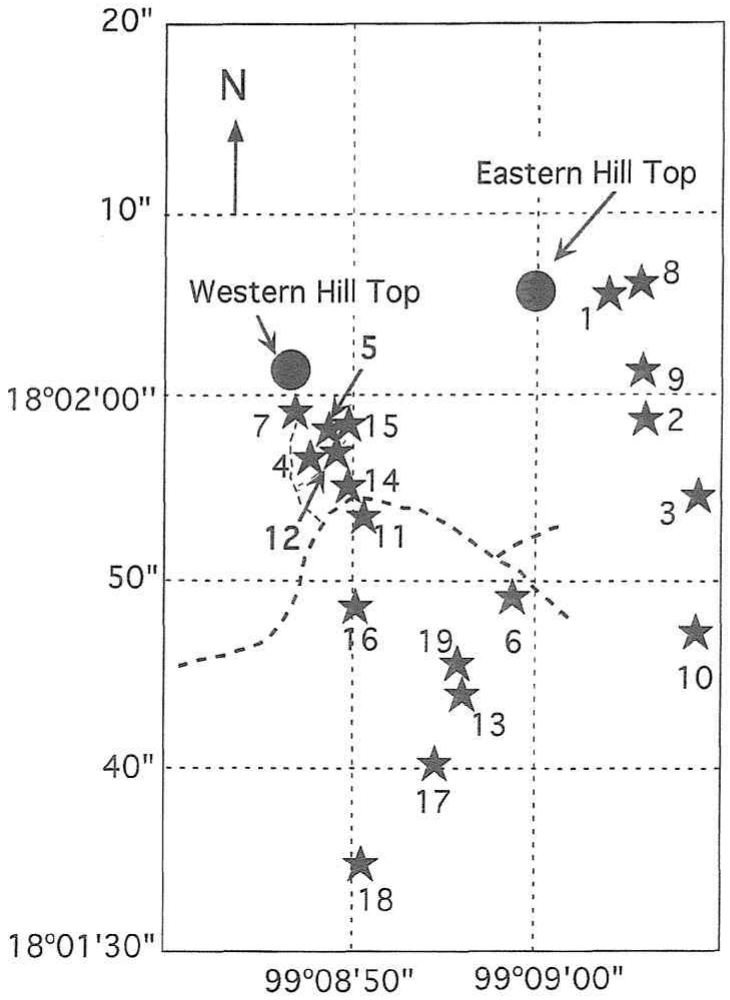

Figure 8. Fossil localities in Sob Mae Tham, plotted according to the GPS data with slight correction of the positions of SMT5 and SMT12, based on the field note of one of us (Y. Kunimatsu). The positions of the Eastern and Western Hill tops are only approximate. The thicker dotted line is an unpaved road (passable by car) coming from the main road. The finer dotted lines are footpaths.

a gentle slope a few tens of meters east of the locality KHT1. The western side is bordered by a fault and a gully. There is a small mound between KHT1 and KHT4. There were petrified woods.

Locality KHT5 (GPS data: N 18° 16' 54.2" E 98° 36' 26.4": This is a locality situated downstream along a small gully from the locality KHT1 (Fig. 7). To the east, beyond a low cliff formed by a fault, lies the locality KHT4. A pile of proboscidean bone fragments were discovered on surface.

2-2. Sob Mae Tham (Locality Prefix: SMT)

Sob Mae Tham is a village ca. 45 km southwest of Lampang. The fossil yielding area, called as Pae Pla Kang (Fig. 8), lies ca. 2.5 km north of the village. It is a hilly area. The area can be seen from the paved main road coming from the village of Sob Mae Tham. There is an unpaved road leading to the area from the main road. Viewed from the south, two bare hills can be used as landmarks. For convenience, we tentatively call them as Eastern and Western Hills in the following section. Local people have known the oc-

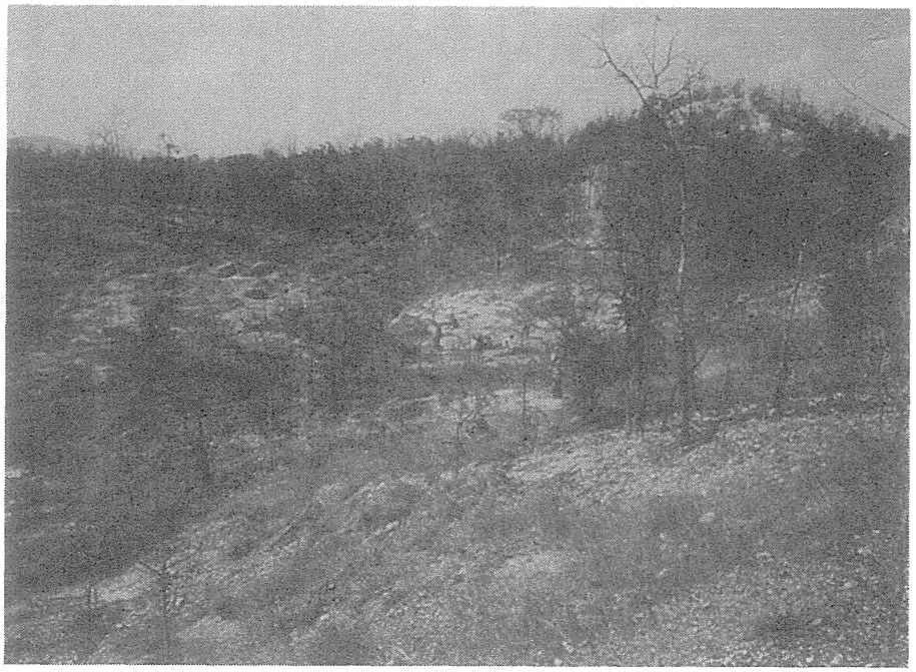

Figure 9. Locality SMT7 viewed from the southeast. The low and bare hill behind is the Western Hill.

currence of fossils in this area for years, and sometimes good fossils were preserved in their houses.

Locality SMT1 (GPS data: N 18° 02' 06.5" E 99° 09' 03.6"): This locality lies on the northern side of a small hill near its summit. Yellowish silt was exposed, and there were a lot of calcareous modules scattered on the ground. Large turtles, crocodile teeth, and coprolites were obtained.

Locality SMT2 (GPS data: N 18° 01' 58.9" E 99° 09' 06.1"): This locality is situated along a corridor running southwards. An upper molar of a bovid, large non-trionychid turtles, and crocodiles were discovered.

Locality SMT3 (GPS data: N 18° 01' 54.8" E 99° 09' 08.5"): This locality is also along the southward corridor, several tens of meters southeast of the locality SMT2. Pharyngeal teeth and bones of fishes, and crocodile teeth were discovered on surface.

Locality SMT4 (GPS data: N 18° 01' 56.7" E 99° 08' 47.3"): This locality is close to the Western Hill, and lies down on the eastern slope from the footpath leading to the locality SMT7. From the locality SMT4, one can see the Western Hill top in the direction

Figure 10. Locality SMT8.

of N20°W. Local villagers, who were guiding us, found large trionychids, and large and small fishes.

Locality SMT5 (GPS data: N 18° 02' 00.3" E 99° 08' 47.9"): This locality is on the opposite slope facing to the locality SMT12. A small gully separates these two localities. The surface is yellowish silt. There were a lot of calcareous modules, whose surface was dark-colored with the inside being yellowish. There were large and small fish remains.

Locality SMT6 (GPS data: N 18° 01' 48.6" E 99° 08' 58.2"): This locality is on the roadside, south of the unpaved road. Fishes, turtles and crocodiles were found on surface.

Locality SMT7 (GPS data: N 18° 01' 56.4" E 99° 08' 46.7"): This is a locality south of the Western Hill (Fig. 9). There were whitish pebbles with some calcareous pebbles on the ground. The surface soil was yellowish, and the sediment below it was bluish white and slightly coarse silt. Bone fragments and vertebrae of fishes, trionychid turtles, a suid upper molar, and talus, metapodial and tibia of equid were discovered.

Locality SMT8 (GPS data: N 18° 02' 06.6" E 99° 09' 05.4"): This locality (Fig. 10) is situated on a ridge west of the locality SMT1. The surface soil is yellowish with bluish white silt underneath. On the ground, there were a lot of calcareous pebbles mixed with

Figure 11. Locality SMT16. A local villager had discovered proboscidean dental remains before we visited to Sob Mae Tham.

whitish pebbles. Crocodile teeth, fish vertebrae, and coprolites were scattered on surface.

Locality SMT9 (GPS data: N 18° 02' 01.6" E 99° 09' 06.7"): This locality lies on the southern slope of a hill. There were a lot of whitish pebbles and some relatively large stones on the ground. The surface soil was yellowish, having bluish white sandstone beneath. There were some calcareous nodules, but they were less in number compared to whitish pebbles. A maxillary fragment of a suid preserving P4-M2 was discovered by T. Tsubamoto. Other fossils were crocodile teeth, bone fragments and pharyngeal teeth of fishes.

Locality SMT10 (GPS data: N 18° 01' 47.7" E 99° 09' 08.8"): This locality is along a small stream in the southern part of the southward corridor from the localities SMT2, 3, & 9. There were calcareous nodules on surface. The surface soil was yellowish, and below it was bluish white but partly reddish silt. Crocodile teeth were found on surface.

Locality SMT11 (GPS data: N 18° 01' 53.7" E 99° 08' 51.0"): This locality is on the southern side of the unpaved road. There were calcareous nodules on surface. A suid upper incisor, fishes, and coprolites were discovered.

Locality SMT12 (GPS data: N 18° 01' 56.4" E 99° 08' 47.5"): This locality is opposite to the locality SMT15 with a small gully running in-between. Vertebrae and bone

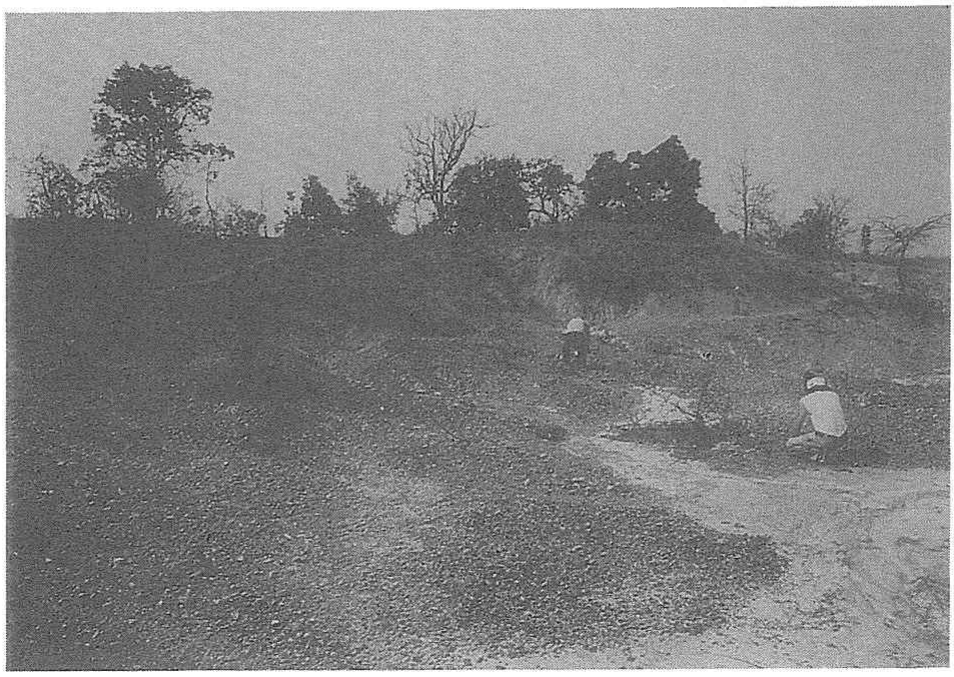

Figure 12. Locality SMT17.

fragments of large and small fishes, postcranial bones of large and small artiodactyls, trionychid turtles, suid lower molars, bovid lower M3 were scattered on surface. Yellowish silt was exposed with calcareous modules on the ground.

Locality SMT13 (GPS data: N 18° 01' 44.2" E 99° 08' 55.6"): This locality is situated next to a crop field. Cranial fragments and vertebrae of fishes and trionychid turtles were discovered.

Locality SMT14 (GPS data: N 18° 01' 54.8" E 99° 08' 50.1"): This locality lies on the northern side of the unpaved road. There were a lot of calcareous nodules on surface.

Locality SMT15 (GPS data: N 18° 01' 59.0" E 99° 08' 49.8"): This locality is close to and east of the locality SMT5. H. Saegusa discovered a humeral distal end of a large mammal, probably rhinocerotid.

Locality SMT16 (GPS data: N 18° 01' 48.4" E 99° 08' 51.2"): Villagers of Sob Mae Tham discovered proboscidean fossils at this place (Fig. 11) before our visit. The locality is near the unpaved road.

Locality SMT17 (GPS data: N 18° 01' 40.5" E 99° 08' 54.7"): There were some bone

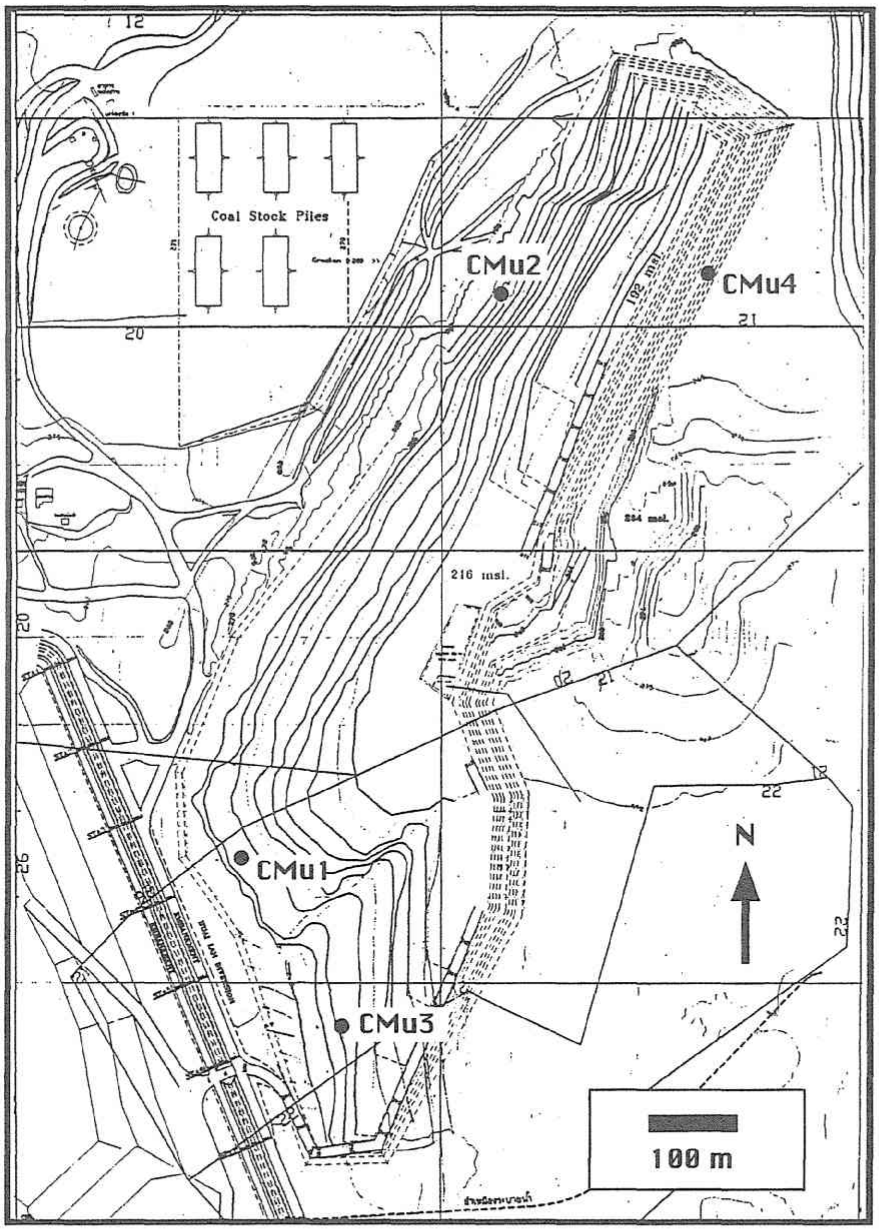

Figure 13. Fossil localities in the Chiang Muan Lignite Mine.

fragments on surface, but this locality was not productive (Fig. 12).

Locality SMT18 (GPS data: N 18° 01' 35.2" E 99° 08' 51.0"): This locality lies midway along a slope of an unpaved lane. A fragment of a proboscidean tusk was found on surface, but it appeared to have been moved from its original place.

Locality SMT19 (GPS data: N 18° 01' 45.9" E 99° 08' 55.5"): There were a number of fish fossils on surface. Some mammalian tooth fragments were also found.

Locality SMT20 (GPS data: N 18° 01' 48.3" E 99° 09' 07.8"): Crocodile teeth and

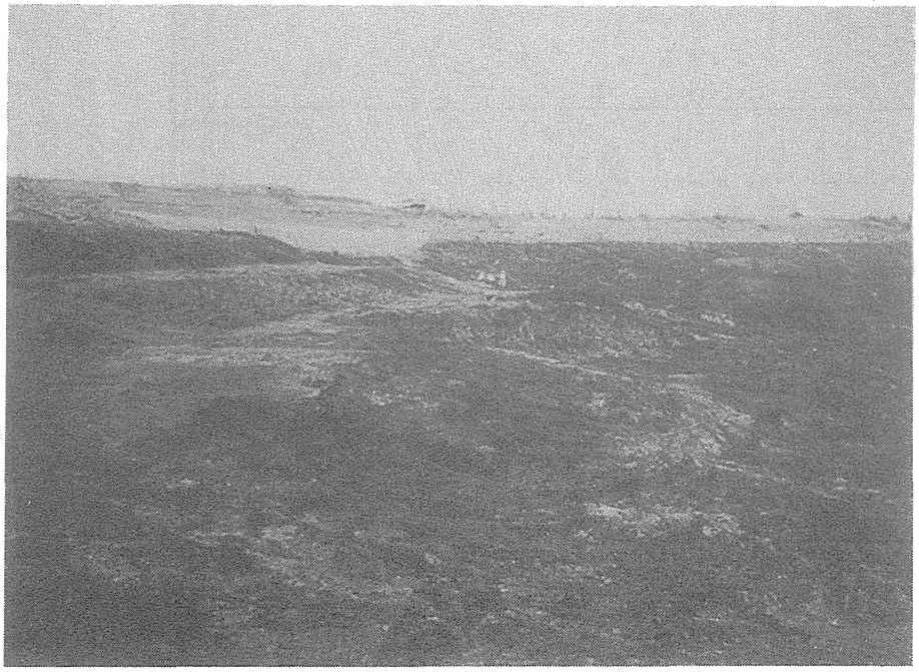

Figure 14. Locality CMu1 viewed from the southeast.

fish pharyngeal teeth were collected. The surface is yellowish silt.

Hominoid fossil

2-3. Chiang Muan (Locality Prefix: CMu)

Chiang Muan is a small-sized lignite mine near the river Yom (Mae Nam Yom) ca. 45 km southeast of Phayao. There are four localities, all of which are situated in the mining pit (Fig. 13).

Locality CMu1 (GPS data: N 18° 56' 18.1" E 100° 14' 02.8"): During the process of lignite mining, mine workers discovered remains of a proboscidean fossil from this locality (Fig. 14). When we visited to the mine, some of the remains were already taken to the mine office. Yet, there were some more bones still preserved in the carbon-rich brown clay. We therefore excavated these remains. They were covered with plaster jackets, and then brought to the National Museum in Chiang Mai (Field No. CMu1-1'99).

Locality CMu2 (GPS data: N 18° 56' 36.3" E 100° 14' 13.3"): This is located ca. 700 m NNE of the locality CMu1. Mine workers previously found proboscidean remains also from this locality. Those fossils were preserved in the mine office.

Locality CMu3 (GPS data: N 18° 56' 10.8" E 100° 14' 05.5"): This locality is situated ca. 200 m SSE of the locality CMu1 on a slope of the mining pit. Plenty of bone fragments

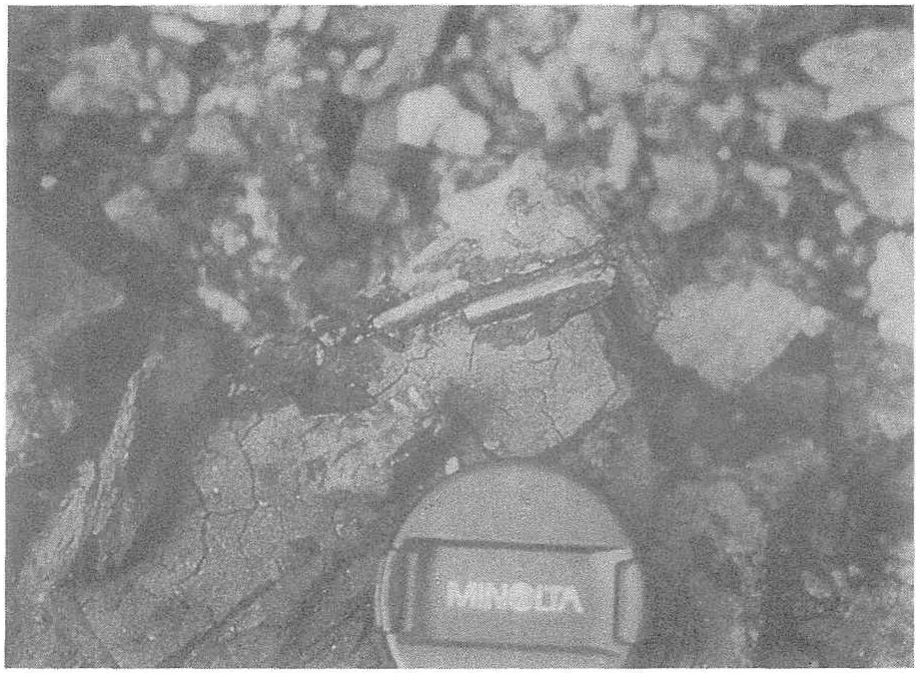

Figure 15. Fossil bones (birds?) in the lignite at the locality CMu3.

of fish and probably of birds were discovered from the lignite (Fig. 15). Many fossils were contained in the muddy part of the lignite near the boundary with whitish clay layer.

Locality CMu4 (GPS data: N 18° 56' 39.1" E 100° 14' 20.4"): This locality lies on the eastern slope of the mining pit, ca. 800 m NE of the locality CMu1. Gastropods, bivalves and crocodile teeth were found from reddish brown coarse sand and clay. The place of finding was ca. two thirds midway up the slope from the bottom of the mining pit.

2-4. Pong Basin

Sickenberg (1971) reported the presence of Deinotherium at Ban Sop Kham in the Pong Basin. Later, French and Thai paleontologists discovered a number of fossils from Huai Siew and Ban San Klang (Fig. 16). During the field season of February 1999, the latter two areas were visited by us.

2-4-1. Huai Siew (Locality Prefix: HS, GPS data: N 19° 11' 17.8" E 100° 17' 37.2")

This locality is situated along the route 1092, a few kilometers away from the town of Pong. During our short visit, petrified woods and gastropods were discovered. According to previous authors (Ginsburg & Thomas 1987, Ducrocq et al. 1994), this locality has yielded several mammalian taxa (Rodentia indet., Anthracotheriidae (Brachyodus sp.), Tragulidae (gen. et sp. indet. & Siamotragulus sanyathanai), Chalicotheriidae

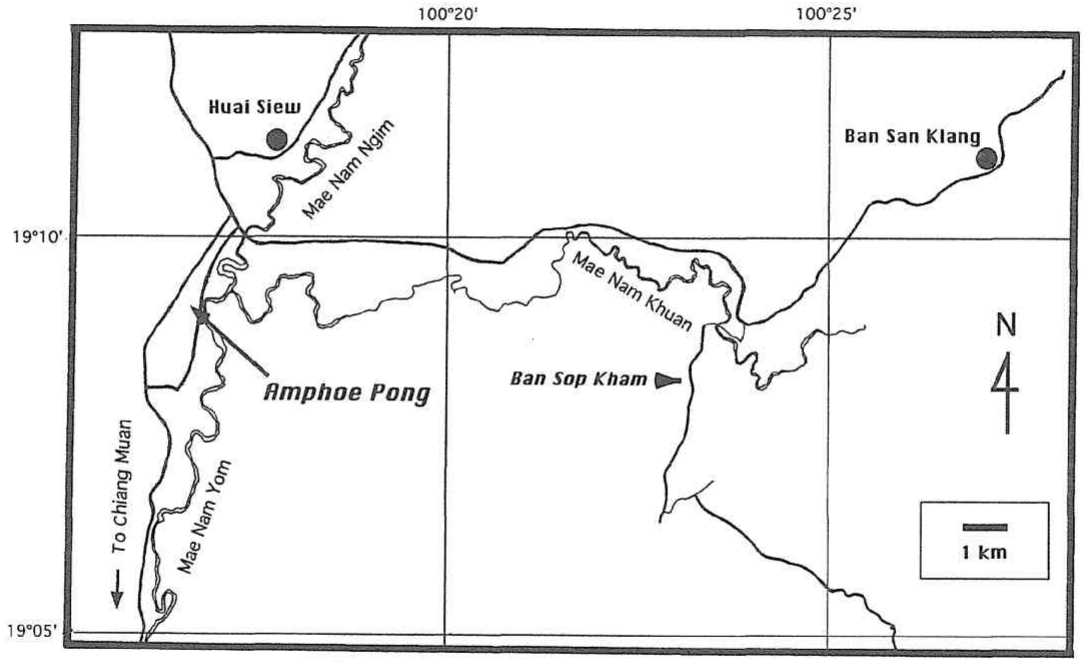

Figure 16. Fossil sites in the Pong area (Huai Siew & Ban San Klang).

(Chalicotherium brevirostre), Rhinocerotidae (Gaindatherium sp.), and Proboscidea (Mastodon indet.), associated with siluriform fishes and some aquatic reptiles (Trionyx, indeterminate emydid turtles, and a longirostrine crocodile). Based on the paleoflora, Vozenin-Serra & Priv-Gill (1989) and Vozenin-Serra et al. (1989) suggested a mangrove environment preceding the rain forest during the Middle Miocene, though they themselves recognized the oddness of the existence of a mangrove forest in the Pong basin, which is now positioned 600 km inland and ca. 300 m in altitude relative to the today's seashore.

2-4-2. Ban San Klang (GPS data [village]: N 19° 10' 59.4" E 100° 27' 11.6")

By now, this is the only place that has yielded a remain of Miocene non-cercopithecoid catarrhine ("Dendropithecus" orientalis) in Southeast Asia (Suteethorn et al. 1990). Previous authors (Ducrocq et al., 1994, Ducrocq et al. 1997) have reported fossil remains of several taxa (erinaceid insectivore, cf. Amphicyon sp., sciurid rodent, Diatomys sp., Conohyus thailandicus, indeterminate tragulid, Siamotragulus sp., Gomphotherium sp.). Unfortunately, no fossil was discovered during our short visit to this area in February 1999.

2-5. Li Basin

There are five areas (Ban Pu, Mae Long, Na Sai, Pa Kha, and Ban Na Klang) that we

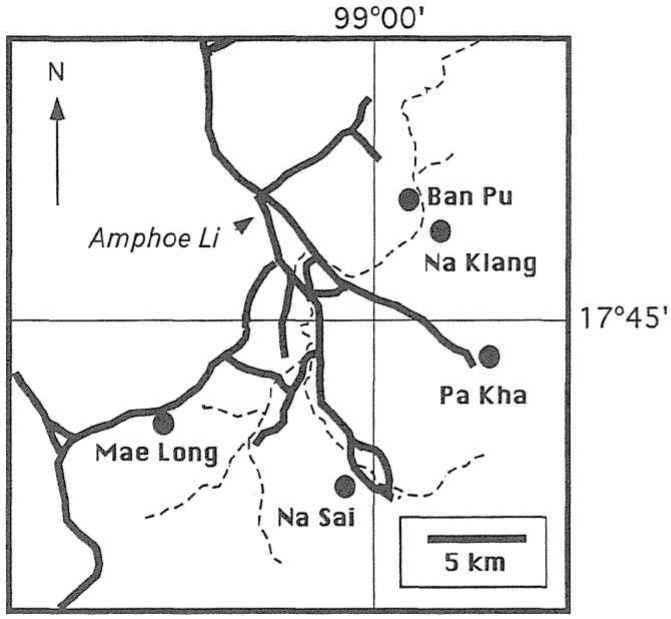

Figure 17. Fossil sites in the Li area.

Figure 18. Locality ML1 (Mae Long).

visited in the Li Basin (Fig. 17).

2-5-1. Ban Pu (Locality Prefix: BP) (GPS data: N 17° 48' 15.0" E 99° 00' 39.9")

This is a lignite mine ca. 7 km east of the town of Li. Lignite seams and clay layers are intercalated. The whitish coarse silt to fine sand of the upper part of the sequence includes thin layers of lignite and iron-rich reddish nodules which often contain petrified woods. Molluscs were sometimes preserved in the lignite.

Figure 19. Na Sai. The lignite is naturally being burnt (see the smoke in the picture).

2-5-2. Mae Long (Locality Prefix: ML)

Locality ML1 (GPS data: N 17° 42' 46.0" E 98° 54' 23.2"): This is a creek close to a small water reserve (Fig. 18). The sediment is whitish to pale greenish clay containing a lot of molluscs. From this locality, previous authors (Jaeger et al. 1985, Mein & Ginsburg 1985, Mein et al. 1990, Mein & Ginsburg 1997, Ginsburg et al. 1988, Buffetaut et al. 1989, Ginsburg et al. 1991, Ducrocq et al. 1994) reported a number of fossils, including a new species of Miocene tarsier Tarsius thailandica (sic.) * (Ginsburg & Mein 1987). We discovered some rodent teeth (Diatomys) through washing and screening the sample of clay collected from this locality.

(*) This specific name should be "thailandicus" (Ducrocq et al. 1994).

Locality ML2 (GPS data: N 17° 42' 12.3" E 98° 54' 23.2"): This is a place near the top of a hill ca. 1 km south of the locality ML1, and ca. 9 km WNW of Na Sai. With the guidance by a local villager, we made a short search for outcrops along dried streams with bushy bamboo vegetation. There was a small outcrop of lignite in a stream, but no fossil was found. The diatomite exposed along the streams contained gastropod shells.

2-5-3. Na Sai (Locality Prefix: NS, GPS data: N 17° 40' 52.2" E 98° 59' 08.9")

This is a small and abandoned lignite mine (Fig. 19). The pit is ca. 200 m wide and 300 m long. A small pond is formed on its bottom. The lignite of this place contains plenty

Figure 20. Fossil leave found at Ban Na Klang.

of sulfur so that yellow lumps of sulfur could be observed here and there on surface. The lignite was naturally being burnt inside (see Fig. 19). A skull of rhinocerotid (cf. Gaindatherium, nicknamed as "Lady Li") was excavated in the field season of 1997 (Saegusa et al., 1999). During the field season of February 1999, we excavated postcranial bones of a large mammal near the place of Lady Li. These postcrania may belong to the same individual with Lady Li. In addition to them, fossil remains of fish, turtles, snakes, and proboscideans were also discovered on surface.

2-5-4. Pa Kha (Locality Prefix: PK, GPS data: N 17° 44' 24.4" E 99° 02' 56.0")

This is a lignite mine ca. 8 km southwest of Ban Pu Mine. An engineer of the mining company, Mr. Tasnai, guided us to the mine. Although we did not find anything of particular interest, Mr. Tasnai told us that they had sometimes discovered fossil molluscs from whitish clay in the mine.

2-5-5. Ban Na Klang (Locality Prefix: NK, GPS data: N 17° 47' 21.9" E 99° 01' 34.9")

This is a lignite mine ca. 2 km southwest of Ban Pu Mine. The sediments were reddish and iron-rich. Petrified woods and fossil leaves were discovered (Fig. 20). The fossil leaves include long and broad leaves (large ones being ca. 20 cm long and several centimeters wide), and Taxodiaceae (Sequoia or Metasequoia) (Fig. 21).

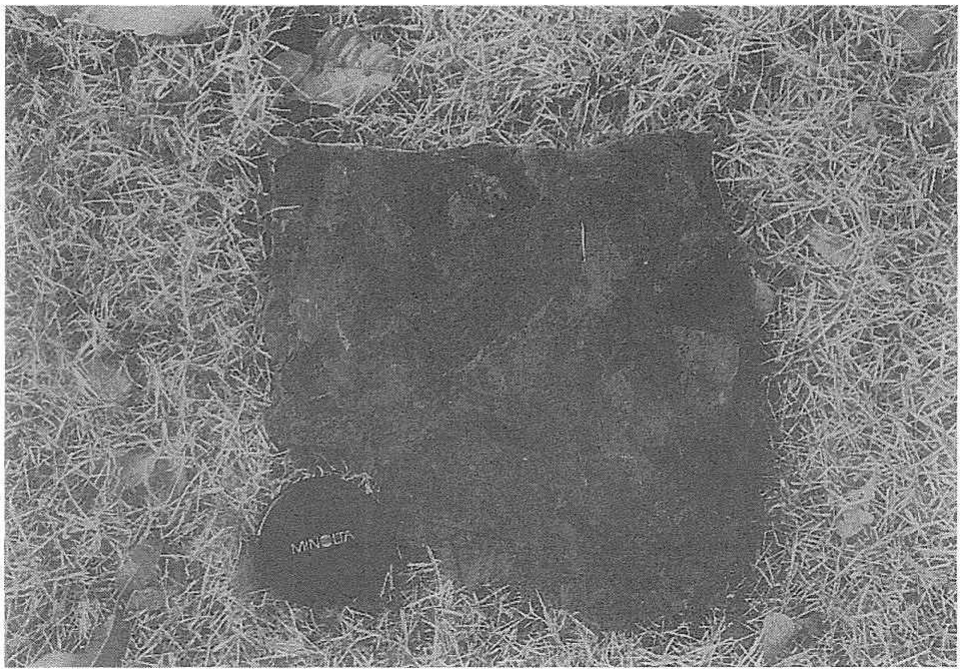

Figure 21. Fossil leave found at Ban Na Klang.

2-6. Mae Moh (Locality Prefix: MM)

This is a huge lignite mine ca. 20 km east of Lampang. The fossil fauna previously known from this mine includes amphibians, fishes, turtles (Trionyx sp.), proboscidean (Stegolophodon cf. latidens), rhinocerotid (Gaindatherium sp.), mustelid carnivore (Siamogale thailandica), suggesting the Middle Miocene in age (Ginsburg et al. 1983, Ducrocq et al. 1994, Tassy et al. 1991). Charophytes collected from the lignite was identified as Nitellopsis sp., a genus distributed between the Upper Oligocene and the Upper Miocene (Ducrocq et al. 1994). During our visit to the Mae Moh Mine, we found fishes, trionychid turtles, coprolites, and the proximal end of a left ulna, probably belonging to a small carnivore.

Locality MM1 (GPS data: N 18° 20' 23.3" E 99° 43' 59.9"): From this locality (Fig. 22), a proximal end of a small carnivore left ulna was discovered on surface. The specimen preserves the olecranon process and the trochlear and radial notches.

Locality MM2 (GPS data: N 18° 20' 58.4" E 99° 43' 30.6"): At this locality, there were plenty of large and small clay blocks, by-products of the mining process, on the ground. We found a relatively well-preserved trionychid turtle from one of such clay blocks.

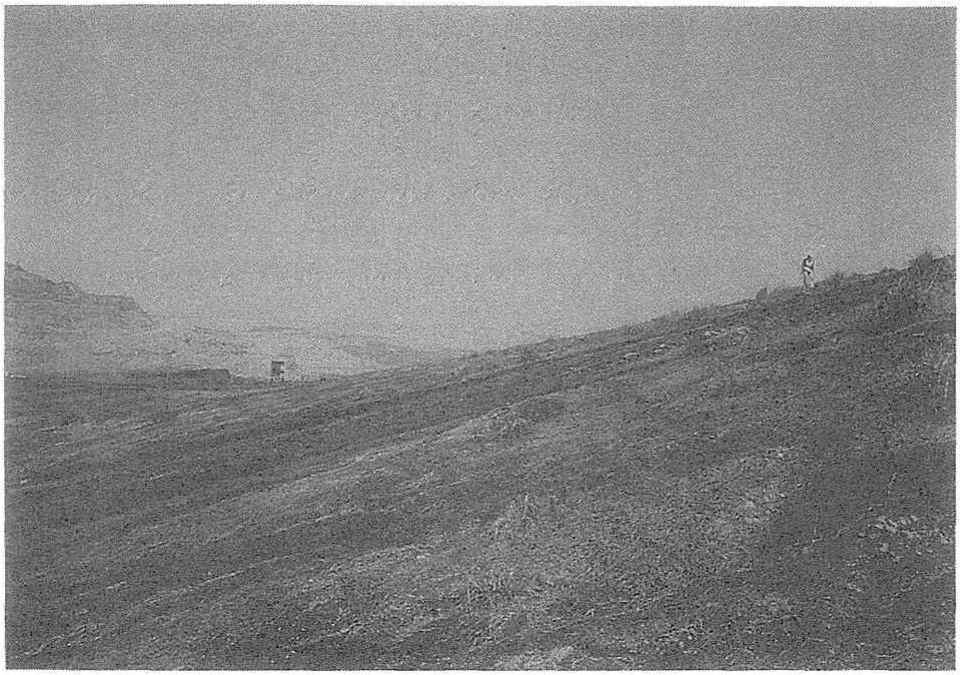

Figure 22. Locality MM1 (Mae Moh Lignite Mine).

2-7. Hab Pu Dai (GPS data: N 18° 00' 51.0" E 99° 19' 02.5")

Near the end of our field survey, we shortly visited a cave deposit locality in Hab Pu Dai. Most of the sediments was already missing, but some fissure filling remained on the cliff. Although we examined the remaining sediments for a while, fossils of particular interest were not obtained this time.

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